Construction Research of Artistic Ceramic Artistic Inspection and Detection System for Artistic Ceramic

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Abstract. Based on the current state of art ceramics research, this article intended to explore the establishment of an art ceramic inspection and testing system, distinguish between the identification of art ceramics and the inspection of art ceramics. It played the role of art practitioners in the field of ceramic inspection and testing, and popularize art ceramics inspection and testing. Popular science knowledge promoted the creation of more outstanding works of ceramic art.

Keywords: artistic ceramics, artistry, inspection and detection

1 Introduction

Art ceramics, also known as display art ceramics, refer to pure art appreciation ceramic products that were made from quartz, feldspar, porcelain clay, etc. These raw materials were manufactured through tire making, polishing, decoration, firing and other processes. It has artistic shapes or patterns, patterns, etc. It is mainly used for display, ornamental or decoration, and is mainly used for ceramic display and practical products for appreciation. It is mainly used for display, ornamental or decoration, and is mainly used for ceramic display and practical products for appreciation. In the quality inspection and testing, this kind of ceramics not only have the basic properties of daily ceramics, but also have the attributes of works of art, which can be viewed and collected. With the development of the economy, more and more people are willing to pay for art, and a considerable number of people begin to collect art ceramics. However, the inspection and testing of artistic ceramics in society, especially the ability to identify artistic qualities, is far behind. The crude and shoddy imitation of famous art ceramics were circulated in the market. It resulted to damage the intellectual property rights of art creators, also have a negative impact on the entire art ceramics market and the art ceramics creation industry.

ADDT 2022, September 16-18, Nanjing, People's Republic of China

DOI 10.4108/eai.16-9-2022.2324894

2 Domestic research status

At present, China has established a relatively complete inspection and testing standard system for the quality and safety of ceramic varieties such as daily-use ceramics, architectural ceramics, and sanitary ceramics. Their quality, safety and performance are relatively well guaranteed. However, as to how ceramics can be transformed into works of art and become artistic ceramics, there is little research and a lack of relevant standards.

Some people in the industry have carried out the construction of "certification traceability standard system". The concept of certified traceability refers to the process of authentication and verifying the anti-counterfeiting traceability based on the unique material characteristics ("fingerprint information") of artworks. According to the principles of standardization, unification, simplification, coordination and optimization, the system is a scientific organic whole composed of standards with internal relations within a certain range [1]. At present, there are 17 kinds of geographical indication products with local characteristics of artistic ceramics in China, and these products are still being explored in various places.

Using the traceability system, the authenticated quality traceability of ceramic artworks can be realized. However, this can only solve the quality of the product. It cannot reflect the artistic value of the product. Because the art has its uniqueness, there is even the view that "mutilation is also beauty". Ensuring product quality only realizes the basic use value of ceramics, but cannot rise to artistic value. In order to express the point of view, the basic quality inspection requirements of artistic ceramics are listed one by one.

2.1 Traditional appearance inspection

Appearance refers to the appearance characteristics of ceramic utensils such as shape, decoration, tire glaze tone, luster, glaze defects, bottom feet, and bottom models [2]. Firstly, the porcelain was checked from its top to bottom and from its inside to outside for deformation, distortion and other defects. In addition, it is necessary to observe whether there is lack of glaze, sticking glaze, falling slag, knocking off porcelain, scar and so on. Secondly, the porcelain was placed under strong light or sunlight to check whether the texture of the porcelain is fine and uniform. Thirdly, check the accessories, such as the ceramic artwork with the handle, the relief in the mouth, the "ears" on both sides of the vase, etc. The firing process of these porcelains were the secondary molding process, which means that these accessories are glued to the main body. It was important to observe carefully the connection parts of porcelain. Maybe there was some gap or lack of glaze. Pay attention to a smooth and natural transition, and no traces of bonding. Fourthly, check whether the craft patterns or engraving patterns on the ceramic artworks are complete, unified, clear and firm. And check whether the decorative gold and silver lines drawn are of the same thickness and bright and beautiful. Fifthly, the products with single-color glaze should be uniform in color and consistent in color. All over the body color Changsha red porcelain was red, and Dehua white porcelain was the overall ivory white. The glaze color of multi-colored ceramic utensils should show the characteristic color of regional ceramics, such as the "colorful" of Yuzhou Jun porcelain. Sixthly, the characters of ceramics must be beautiful in shape and distinct in layers if there are portraits or character decorations on the ceramics, whatever it is underglaze or overglaze. Seventhly, check whether the shapes, patterns and colors of

each part of the complete set of ceramic vessels are consistent, coordinated and matched. The quality grading of art ceramics can be realized through the traditional appearance inspection.

2.2 Advantages and disadvantages of traditional appearance detection methods

Traditional testing usually relied on professional technicians to use manual methods to determine the quality of products. However, its shortcomings were also obvious. There would be differences in the professional level, personal experience and cognitive level of the testers, which made the test more subjective. Therefore, the test was easy to lack of the science and rigor, could not meet the real needs of art ceramic art detection.

2.3 Modern NDT

According to the International Society for Testing and Materials (ASTM), non-destructive testing is defined as the use of technical means to detect, locate, measure, assess and evaluate flaws. Its integrity, material properties and composition were evaluated and geometric features were measured [3]. In addition to surface penetration testing, the methods used for non-destructive testing of ceramics mainly include machine vision measurement technology (MVMT), X-ray computed tomography (X-CT technology), X-ray fluorescence, X-ray diffraction, etc. Among them, MVMT was a technology that used digital image processing technology to quickly detect the appearance quality defects of art ceramics. It had been widely researched since it could overcome the phenomenon of false detection and missed detection when manual detection.

Cracks and slagging were the main factors affecting bowl art ceramics. Machine vision measurement technology needed to go through the following steps to detect dirt and cracks, as shown in the figure 1.

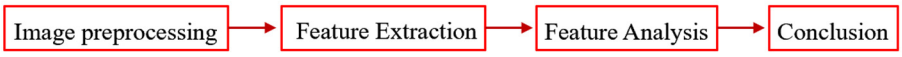

Fig. 1. The algorithm flow of cracks and slagging [Own copyright]

Taking a white porcelain bowl as an example, the gray level in the bowl should be stretched to reduce the pixel value of the defect color in the bowl and increase the pixel value of other parts to facilitate feature extraction. The colors of the images were divided into three categories. One was a pure black background with the lowest gray value. Another was the whitest color at the bottom of the bowl. The third was the color of the bottom of the bowl and the background was between the brightest and darkest color. Defects were caused by cracks in the bowl and slag spots in the bowl.

The pixel value of the collected defect image was low due to its rough surface, mainly diffuse reflection, disorderly reflected light, insufficient light into the camera and other reasons. If the defect was dark, the gray value of the adjacent area was higher than that of the defect. From this point, the defect area was extracted and the characteristics of the defect were analyzed quantitatively.

2.3.1 The image was initially stretched for contrast and variation.

In order to extract the defect area, it was necessary to increase the contrast between the pixels at the defect and the pixels in other areas. First, the image was gray processed, and then the it was processed using IMADJUST, a function in MATLAB software.

From the perspective of image transformation, the gray histogram area of the original image (figure 2a) was concentrated, and the overall pixel difference was not big, which was inconvenient for feature analysis and extraction. The image with increased contrast was shown in figure 2b. The image changes significantly, which was helpful for the next step of increasing image contrast and extracting defect features.

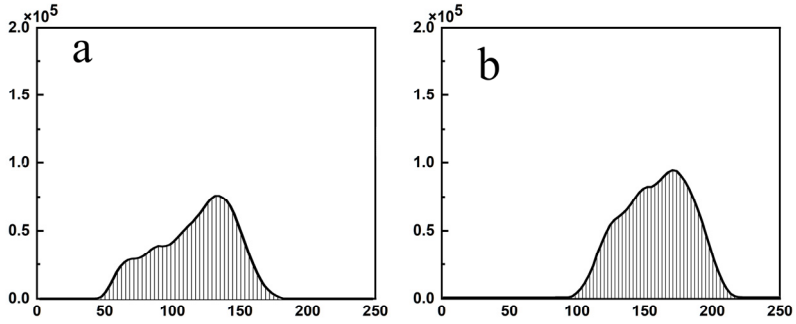

Fig. 2. The image before (a) and after (b) the change [Own copyright]

2.3.2 Using linear gray transformation to increase the contrast of the image.

In the figure 2, the histogram near zero corresponded to the histogram of the background. The gray value of the area where the ceramic bowl was located was mainly between 150 and 250. So, this area was contrast stretched.

The pixels inside the white porcelain bowl were divided into two parts. The area at the bottom of the bowl had a larger number of pixels. The second part extended from the mouth of the bowl down to the bottom of the bowl. The pixel value of the defect fell in the lower area. According to the analysis, the image contrast could be enhanced by using linear piecewise gray transformation.

Linear gray transformation was used to enhance the required contrast of the regionand suppress some gray intervals [5]. The image before processing was shown in figure 3a. Its gray scale was dark and the defect features were not obvious. After processing, as shown in figure 3b, the contrast effect of defect features in the whole image was remarkable after overall contrast-degree was stretched.

Fig. 3. The image before (a) and after (b) linear gray transformation [Own copyright]

2.3.3 Point detects using the boundary detection operator.

Defects in the inner wall of the bowl were inspected. After linear transformation, the contrast of feature defects in the whole image was enhanced. The boundary detection operator was used to process the processed image. The Laplacian point detection operator was used here, which could detect the slag points and cracks together at the same time. The execution efficiency of the algorithm was improved. Point detection operator was used to extract the defects in the bowl as shown in figure 4.

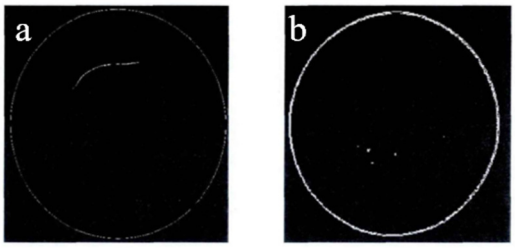

Fig. 4. The image before (a) and after (b) the boundary detection operator [Own copyright]

2.3.4 Detects extraction.

In some regions, the features to be extracted were breakpoints. In others, a region was divided into two or more unconnected sections. This kind of region could be expanded by morphological image processing technology. In order to remove the outer boundary of figure 4, the expansion effect could be appropriately exaggerated by adopting the expansion operator. The expanded image was shown in figure 5.

Fig. 5. The factors of expansion and the image after the expansion operator [Own copyright]

2.3.5 Defect feature extraction and analysis.

The number and size of defective areas in the bowl were affected by the algorithm. A good algorithm not only could obtain more accurate region shape, but also could extract more complete defect number. If the defect was not clear, the extracted defect could be inflated again. The factors of expansion and the image of defects in bowl after the expansion operator was shown in figure 6.

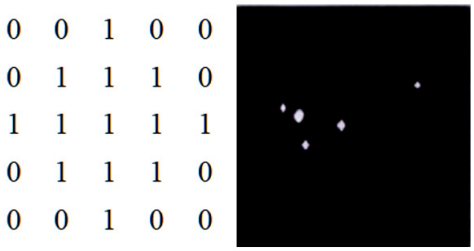

Fig. 6. The factors of expansion and the image of defects in bowl after the expansion operator [Own copyright]

2.3.6 Experimental and Analysis.

Take the detection of white porcelain bowl as an example to explain the technology. When there was a defect in the bowl, a defect image in the bowl was final extracted. When there was no defect, a black screen image was final extracted. The product corresponding to the black screen image is a qualified product without defects. The experimental results were shown in Table 1 and Table 2.

Table 1. The detection of white porcelain bowl with slagging defeat [Own copyright]

category	Region 1	Region 2	Region 3	Region 4	Region 5
area	12	31	17	23	12
Long axis	4.3036	6.9600	5.1540	5.6469	4.3036
Short axis	4.3036	6.1283	4.7510	5.6469	4.3036
Eccentricity	1	1.1345	1.0836	1	1
Result	slagging	slagging	slagging	slagging	slagging

Table 2. The detection of white porcelain bowl with cracks and slagging defeat [Own copyright]

category	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
area	303	6371	90	74	48	48
Long axis	39.4845	642.3377	11.3765	10.5910	8.3404	8.3404
Short axis	10.0843	93.6228	10.3368	9.1601	7.0676	7.0676
Eccentricity	3.9141	6.8601	1.1002	1.1553	1.0953	1.0953
Result	cracks	cracks	slagging	slagging	slagging	slagging

2.4 Advantages and disadvantages of modern inspection

Compared with manual testing, the biggest advantage of using computer testing was that it had data comparison, high fairness, wide penetration rate, and low requirements for the artistic literacy of testing personnel. It could be used as a universal tool for large-scale promotion. However, the accompanying disadvantage was that it was one-size-fits-all. It was only suitable for industrial inspection of assembly lines, but not for the detection of uniqueness of artworks, which would easily obliterate the artistry of some works.

3 Thoughts and suggestions on the status quo

So how to solve the above problems, the author gave the following suggestions.

3.1 Establish a complete standardization system for artistic ceramics

In recent years, various types of ceramic industries have established relevant standardization committees with the rapid development of the ceramic industry. By formulating the standardization framework of the industry in this field, improving the standard process, formulating and revising local standards and industry standards, and rationalizing the marketization mechanism, so as to lead the healthy and sustainable development of the industry [4]. Some ceramics such as sanitary ceramics, building ceramics, etc., had formed a standard product, standard mandatory, standard testing methods and other complete standard system. However, in terms of art ceramics, there were lack of the establishment of professional standardization technical committee and the establishment of relevant industry standards and local standards. For example, the industry standard SN/T0741-2010 "Import and Export Ceramics Inspection Regulations for Displaying Art Ceramics" was only aimed at importing and exporting art. The local standard of Fujian and Guangdong Province "the limit of energy consumption per unit product for the display of art ceramics" only focused normative requirements for the relevant energy consumption of art ceramics. The provincial standard of Henan Province DB41/T 1613-2018 "Porcelain Furnishings in Pearl Fields" partially regulated the artistic standards for ornamental porcelain in pearl fields, which played a certain leading role. Jiangxi Provincial Local Standard DB36/T926-2016 "Jingdezhen Traditional Porcelain Craftsmanship" was leading the Jingdezhen artistic ceramics. The establishment of the standardization system had a leading advantage, but it was not enough to support the needs of the development of its art ceramic industry [5]. The above listed standardization systems paid attention in the aspects of quality evaluation, pricing principles, inheritance and protection, and technological processes of art ceramics. Therefore, the establishment of a perfect standardization system for artistic ceramics was a powerful means of evaluating the value of artistic ceramics.

3.2 Cultivate the diversity of talents in the inspection and testing team of artistic ceramics

An interdisciplinary professional team should be formed in the artistic ceramics inspection and testing institution in order to increase the applicability, compatibility and diversity of the construction of the standardization system of artistic ceramics. These field should be included in ceramic materials, fine arts, archaeology, statistics, computers, etc. A closed loop of inspection and detection which was combined with local reality and detection direction, dynamically detects different artistic ceramic fields should be established. It would avoid the phenomenon of emphasizing quality over art, and also eliminate the appearance of false art works that were only art but have no quality.

3.3 Establish different categories of ceramic inspection, detection and authenticity identification

When the author reviewed the materials relevant to the inspection and testing of art ceramics, it was found that more researchers focused on authenticity when inspecting and testing art ceramics. Authenticity was just an artistic quality (or a business card of an identity) that had the ultimate character. It was only applicable to famous artists or artists' hands. If it was mass-produced ceramics or small art pieces scattered on the street, it couldnot be defined by the concept of authenticity. However, art had no boundaries. Therefore, the inspection and testing process of artistic ceramics could be established through two systems. For known artists, or known cultural relics unearthed ceramics, scientific detection methods and database establishment were used to determine their uniqueness. For mass-produced, or mass-produced art ceramics by unknown designers, a standardized testing process was adopted to form the grades of ordinary products, fine products, works of art, and collectibles. Unique identifiers were incorporated into the database. In the subsequent circulation, the authenticity of art ceramics could be determined through this unique identification, which was helpful to maintain the creator's labor input and artistic contribution.

3.4 Give full play to the professional strength of art practitioners in the field of inspection and testing

In addition to the natural beauty of shape, texture, and color, ceramic art also had the beauty of reprocessing, such as ceramics combining painting and decoration techniques. Painting was the expression of the spiritual world and a reproducible external observation. Ceramic firing was based on life. When the two were combined, the artistic conception of the unrealistic expression of the life world would be realized [6]. It could not only enrich the decorative effect of the ceramic surface, but also increased the artistry and the inherent semantics of the ceramic utensil itself. The plasticity and diversity of the ceramics, as well as the diversified development trend caused by the change of painting art form, could enhance modern art and consumer purchasing power. In the process of inspection and testing, the artistic judgment and the division of art categories given by art practitioners were more convincing for artistic products than simple appearance inspection.

3.5 Cultivate consumers' ability to appreciate and purchase art ceramics

We supposed that the producer of art ceramics was 0, the inspection and detection of art ceramics was 1. It was difficult to go from 0 to 1. However, it was more difficult in the appreciation

and discernment of art, which was a scale from 1 to 5. As an inspection and testing institution, it could use the form of science popularization to go into communities, schools and enterprises, and carry out professional training such as standardization publicity, art ceramic appreciation and ceramic quality popularization. Gradually established from ceramic quality to art ceramic quality, and then to art ceramic quality of the masses. Level acceptance, which required a long process and specialized training, was a direction that requires continuous effort.

3.6 Establish an Art Ceramics Tasting Center

Tasting was to use the sense of smell, taste, senses, and instruments to keep the fake and keep the true. A good database included the warehouse and sold goods should be established. Professional tasting was used to reassure consumers and make customers satisfied. It also provided certification, commitment, and tasting services. This was a unique way of demonstrating the great value of a database center. The Commodity Integrity Database Tasting Center was a tasting department set up by the database to test whether the products of the warehoused enterprises meet the conditions for sale on the shelves. It could test the quality and safety of the products, and provide basic guarantee for the safety of consumers' lives and properties. In order to ensure product quality, the Tasting Center would strictly follow the standards to test the various indicators and data of various commodities before they could be put on the shelves. Various product data and tasting reports should be loaded to the product traceability channel and present them to consumers clearly. Really practice quality assurance. For each commodity, we needed to ensure that the source can be traced, the destination could be traced, and the responsibility could be investigated. The Tasting Center was the basis for product quality assurance. It strictly controls quality issues, adheres to product quality and quality checkpoints, conducts rigorous testing of enterprise products, and brought truly high-quality products to the market. For products that failed the quality inspection, immediately contact the merchant to make corresponding adjustments before putting them on the shelves.

4 Conclusion

Chinese ceramic art was a legend written by fire and mud. It had a long history and indelible art forms in China. Under the background of the rapid development of ceramic technology, how to use the strength of inspection and testing to promote ceramic art to reflected the value of Chinese culture and create enough symbols? It deserves all of us to think about. This is also the reason why the author wanted to advocate and recommend the establishment of an inspection and testing system for artistic ceramics. Chinese president Xi Jinping once commented on the excavation and understanding of the cultural connotation of works of art. We needed to appreciate the exquisite goods they produce and the human spirit they contain, and showed the spirit they contain through their performances[7]. As an inspection and testing institution, popular science was as important as science humanities. Multi-disciplinary cooperation was necessary to break down the barriers between science and art.

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